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Abstract: Improved approaches to assist those having hearing loss are disclosed. One approach pertains to providing on-line hearing loss testing. The on-line hearing loss testing can be self-performed without any specialized equipment. Another approach pertains to on-line sound customization. The sound customization can simulate hearing compensation on-line. As an example, the hearing compensation can be used to simulate hearing aid processing. Still another approach pertains to a recommendation and/or referral procedure.
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METHOD AND SYSTEM FOR ON-LINEHEARING EXAMINATION AND CORRECTION

BACKGROUND OF THE INVENTION

1. Field of the InventionThe present invention relates to hearing loss and, more particularly, tohearing loss evaluation and correction assistance.

DESCRIPTION OF THE RELATED ART

One out of ten people suffer from some degree of hearing loss. However,io due to stigma, cost, and availability only about 25% of those who have hearingloss wear hearing aids. Many people do not want to wear hearing aids becausethey view hearing aids as a symbol of disability. In many countries (including theUnited States) hearing specialists, such as audiologists, perform hearing lossdiagnosis. The diagnosis and subsequent fitting of a hearing aid device is acostly process. In developing countries, hearing specialists are rare and thuspeople of developing counties are often unable to get assistance. There are alsomany people with impaired hearing that are not aware that they have impairedhearing. Many people in this category are reluctant to spend the time andmoney to have their hearing examined by a hearing specialist.

More particularly, in most developed countries, hearing loss is diagnosedusing specialized equipment known as an audiometer. Typically, a patient mustvisit a hearing specialist's office or an ear, noise and throat (ENT) doctor's officeto have hearing loss testing performed. If hearing loss is diagnosed, the hearingspecialist or doctor will counsel the patient to consider using hearing aid. If thepatient chooses to purchase a hearing aid, the hearing specialist or doctor has tospend additional time to fit the hearing aid for the patient. All these services areexpensive and usually not covered by insurance or the government.

As noted above, the conventional hearing loss testing is performed usingan audiometer. The audiometer presents a calibrated pure tone signal to thepatient via a transducer such as a headphone, an insert earphone, or a loud-1speaker to one of the patient's two ears. If the patient hears the tone, the levelof the tone will be reduced and presented to the patient again. If the patientcannot hear the tone, the level of the tone will be increased and presented topatient again. This procedure will repeat many times until certain number ofreversals from decreasing the tone to increasing the tone has been reached.

The hearing threshold of the patient is defined as the signal level at which thepatient can hear the tone 50% percent of the time the tone is presented to thepatient. The hearing threshold can be derived from the various reversal levels.

For each ear, the above procedure is usually repeated at 125, 250, 500, 1000,lo 2000, 4000, and 8000 Hz. If the difference of the hearing thresholds at twoadjacent frequencies exceeds a critical value (e.g., 20 dB), an additional test canbe performed at a middle frequency. Often middle frequencies are only applied,when needed, for frequencies between 500 to 8000 Hz. Accordingly, themaximum number of testing frequencies is usually eleven (e.g., 125, 250;

500@750,1500, 2000@ 3000@ 4000, 6000, and 8000 Hz).

In order for the hearing loss test results to be meaningful, the testingsystem (namely, the audiometer) must be calibrated. In other words, therelationship between the electrical settings in the system and the acousticalpressure delivered to subjects must be known. Various components affect thecalibration including, but not limited to, electrical system that generates thestimuli and listening system (transducer) that converts electrical signal intoacoustic pressure. Calibration is further complicated by the fact that sound levelmeasured at the eardrum of a human varies from person to person even whendelivered with the same system and identical settings. As a result, calibration ofa testing system is often conventionally done using a special coupler for which areference hearing level of normal listeners has been established. For example,the audiometer with an insertion earphone is usually calibrated in a 2 cubic-centimeters (cc) coupler. When listeners with normal hearing listen to puretones through an insertion earphone, the sound levels, as measured in the 2 cccoupler, of the pure tones need to be set to the following levels (given in SoundPressure Level (SPL)) for the sounds to be just audible.

2.e R= Ere 1453520750 1 51000 101500 82000 73000 124000 206000 278000 30The above levels are called normal reference levels of the insertion earphone inthe 2 cc coupler. The reference levels vary for different transducers as well asdifferent couplers.

Hearing thresholds for a patient are usually expressed in decibels hearinglevel (dB HL), which is a relative level in reference to the normal referencelevels. The reference levels should have been established for the system andtransducer used in the test. For example, the normal reference level for anlo insertion earphone is 7 dB SPIL at 2000 Hz as measured in a 2 cc coupler. If thehearing level for a patient is 47 dB SPL at the same frequency as measured inthe same 2 cc coupler, the hearing loss for the patient is 47-7 = 40 dB HIL. Formost commercial audiometers, the normal reference levels can be built-in themachine, and the signal level presented to patient is automatically expressed indB HL.

Accordingly, there are various problems associated with conventionalhearing loss testing. One problem with conventional hearing loss testing is thatspecialized testing equipment must be used and that the testing equipment mustbe calibrated. Another problem with conventional hearing loss testing is thecosts and often limited availability of hearing specialists or ENT doctors toadministrator the hearing loss examination. As a result, for various reasons,3hearing loss testing and hearing loss assistance are generally not readilyavailable to people.

Thus, there is a need for improved approaches to evaluating hearing lossand assisting those with hearing loss to obtain hearing assistance products orservices.

SUMMARY OF THE INVENTION

Broadly speaking, the invention relates to improved ways to assist thosehaving hearing loss. One aspect of the invention pertains to providing on-lineto hearing loss testing. The on-line hearing loss testing can be self-performedwithout any specialized equipment. Another aspect of the invention pertains toon-line sound custornization. The sound custornization can simulate hearingcompensation on-line. As an example, the hearing compensation can be usedto simulate hearing aid processing. The sound custornization can also simulatehearing loss. Still another aspect of the invention pertains to a recommendationand/or referral procedure. Yet another aspect of the invention pertains to on-

linehearing aid purchasing. The invention can be implemented in numerous waysincluding as a method, system, apparatus, device, and computer readablemedium. Several embodiments of the invention are discussed below.

Other aspects and advantages of the invention will become apparent fromthe following detailed description taken in conjunction with the accompanyingdrawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be readily understood by the following detaileddescription in conjunction with the accompanying drawings, wherein likereference numerals designate like structural elements, and in which.

I FIG. 1 is a network-based hearing evaluation and compensation systemaccording to one embodiment of the invention;4FIG. 2 is a block diagram of relative hearing loss evaluation processingaccording to one embodiment of the invention;FIG. 3 is a flow diagram of reference subject hearing loss processingaccording to one embodiment of the invention;FIG. 4 is a flow diagram of target subject hearing loss processingaccording to one embodiment of the invention;FIG. 5A is a flow diagram of on-line sound processing according to oneembodiment of the invention;FIG. 5B is a flow diagram of on-line hearing loss simulation processinglo 550 according to one embodiment of the invention;FIG. 6A - 6D are flow diagrams of hearing assistance processingaccording to one embodiment of the invention;FIG. 7 is a screen depiction of a user interface for a local machine;FIG. 8 is a block diagram of calibration-based hearing loss evaluationprocessing according to one embodiment of the invention; andFIG. 9 is a flow diagram of calibration processing according to oneembodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The invention relates to improved ways to assist those having hearingloss. One aspect of the invention pertains to providing on-line hearing losstesting. The on-line hearing loss testing can be self-performed without anyspecialized equipment. Another aspect of the invention pertains to on-line soundcustomization. The sound custornization can simulate hearing compensation on-line. As an example, the hearing compensation can be used to simulate hearingaid processing. Still another aspect of the invention pertains to arecommendation and/or referral procedure.

Embodiments of this aspect of the invention are discussed below withreference to FIGs. 1 - 9. However, those skilled in the art will readily appreciate5that the detailed description given herein with respect to these figures is forexplanatory purposes as the invention extends beyond these limitedembodiments.

FIG. 1 is a network-based hearing evaluation and compensation system1 00 according to one embodiment of the invention. The network-based hearingevaluation and compensation system 1 00 includes a data network 102. Thedata network 102 can take a variety of forms. The data network 102 provides acommunication network through which a hearing assistant server 104 cancommunicate with local machines 106 and 108. For example, the data networkio 102 can be or include the Internet, a wide area network (WAN), or a local areanetwork (LAN). The data network 102 can also include a telephone network or acable network. The data network 102 can also be wired or wireless, or acombination of both.

As shown in FIG. 1, the local machine 106 includes an audio component110andthelocalmachinelO8includesanaudiocomponentll2. Itshouldbeunderstood that the network-based hearing evaluation and compensation system1 00 can include one or more local machines, such as the local machines 106and 108. The audio components 1 1 0 and 1 1 2 of the local machines 106 and108, respectively, provide for an audio (or sound) output at the local machine.Asound output provided by the audio components 1 1 0 and 1 1 2 is directed at asubject. Typically, the subject is the user of the corresponding local machine.

The audio components 1 1 0 and 1 1 2 can take a variety of forms. For example,the audio components 1 1 0 and 1 1 2 can pertain to a sound card residing in thelocal machine together with a speaker(s) (loud-speaker(s)), earphone orheadset. As another example, the audio components 1 1 0 and 1 1 2 can pertainto a peripheral device that couples to the local machine. In one implementation,the local machine is a personal computer and thus typically includes one or moreaudio components. In another implementation, the local machine has a networkbrowser thereon for accessing the data network 102.

The network-based hearing evaluation and compensation system 100operates in a client-server manner, wherein the hearing assistant server 104 is6the server and the local machines 106 and 108 are clients. The local machines106 and 108 can interact with the hearing assistant server 104 to perform on-linehearing evaluations (examinations). As noted above, the hearing evaluationsare for subjects, which are typically the users at the local machines. In addition,the local machines 106 and 108 can also access the hearing assistant server104 to simulate hearing corrections for the subjects (users). For example, if auser of a particular local machine desires to hear a music file residing on thehearing assistant server 104 (or other remote server device coupled the datanetwork 102), the hearing assistant server 104 can manipulate the standardlo sound file to provide for corrections that are associated with compensating forthe hearing loss associated with the user of the particular local machine.

Consequently, the user of the local machine can hear the sound after it has beencorrected for their particular hearing loss.

Furthermore, the network-based hearing evaluation and compensationsystem 1 00 can also include a hearing aid service provider 1 1 4. Typically, thelocal machines 106 and 108 can access the hearing aid service provider 114through the data network 102. In addition, the hearing assistant server 104 canrefer or direct certain subjects (users) to the hearing aid service provider 1 14.

Typically, the referral could be made after the subject has indicated a desire for a2o hearing aid product or service that is offered by the hearing aid service provider1 1 4. The on-line results of the hearing evaluation for the subject can also beforwarded to the hearing aid service provider 1 14 with the referral. Although onlya single hearing aid service provider is illustrated in FIG. 1 @ it should beunderstood that the network-based hearing evaluation and compensation system1 00 would typically service a plurality of hearing aid service providers.

FIG. 2 is a block diagram of relative hearing loss evaluation processing200 according to one embodiment of the invention. The relative hearing lossevaluation processing 200 initially provides 202 a reference subject at a localmachine. As examples, the reference subject can be a young person known to3o have normal hearing, a person whose hearing loss is known, or a person whosehearing can be identified as normal hearing such as by listening to some

natural7sounds or sounds generated from special devices that have been calibrated toproduce sound at certain levels. The local machine is, for example, a personalcomputer having a network browser thereon. Next, an on-line hearing loss testis performed 204 with the reference subject at the local machine. The on-linehearing test establishes reference parameters. In one embodiment, thesereference parameters are normal reference levels. The particulars of hearingloss tests, such as tone frequency and amplitude, are generally well known inthe art. However, according to the invention, the hearing loss test is performedon-line. As an example, the on-line hearing loss test can be controlled by theio hearing assistant server 104 illustrated in FIG. 1 such that the reference subjectpositioned proximate to the local machine 106 or 108 can receive sound signalsassociated with the hearing loss test and respond them at the local machine. Atthis point having performed the on-lined hearing loss test with respect to thereferenced subject, reference parameters for various frequencies are known.

Next, by using these reference perimeters as a base line condition, therelative hearing loss of a particular subject (target subject) can be determined.

Once there is a target subject that desires his or her hearing to be evaluated, therelatively hearing loss evaluation processing 200 continues. Namely, the targetsubject is provided 206 at the local machine. The local machine used by thetarget subject is the same local machine that was used by the reference subjectto obtain the referenced perimeters at operation 204. After the target subject isprovided 206 at the local machine, an on-line hearing loss test is performed 208with the target subject at the local machine. The on-line hearing loss testestablishes target parameters. In one embodiment, the target parameters arehearing loss levels.

Thereafter, hearing loss of the target subject can be determined 21 0based on the target perimeters and the referenced perimeters. In oneembodiment, the hearing loss is expressed as various hearing thresholds fordifferent frequencies. Typically, the hearing loss is expressed relative to normal3o hearing as determined by the reference parameters (such as numerical valuesrelative to the reference parameters). After the hearing loss has been8determined 21 0, the relative hearing loss evaluation processing 200 ends. Notethat relative hearing loss evaluation processing 200 does not require any specialpurpose hardware, merely a local machine (e.g., personal computer having anetwork browser with access to a data network) and an audio component (e.g.,sound card and speaker).

Although in FIG. 2 the reference subject is tested before the targetsubject, the reverse situation can be also used. Namely, the target subject canbe tested first and then subsequently the reference subject tested. Further, thetest data from the testing of a single reference subject can be used to test one orio many different target subjects. In any case, settings at the local machine thataffect its audio output should not be altered or modified between testing of thereference and the target(s) subjects.

FIG. 3 is a flow diagram of reference subject hearing loss processing 300according to one embodiment of the invention. The reference subject hearingloss processing 300 is, for example, additional detail on the operationsperformed with respect to the on-line hearing loss test for the reference subjectat operation 204 illustrated in FIG. 2.

The reference subject hearing loss processing 300 initially provides 302 areference subject at a local machine. Then, sound is generated 304 at the localmachine for a first tone. A decision 306 then determines whether the referencesubject's response to

the sound generated 304 at the local machine has beenreceived. When a decision 306 determines that the reference subject'sresponse is not yet received, the reference subject hearing loss processing 300awaits such a response. Once the decision 306 determines that the referencesubject's response has been received, a decision 308 determines whether a nexttone should be processed. When a decision 308 determines that the next toneshould not yet be processed, then the level of the tone (current tone) is adjusted31 0. Here, the level of the tone is typically adjusted up or down and then theprocessing returns to, repeat the operation 304 and subsequent operations. Onthe other hand, when the decision 308 determines that a next tone is to beprocessed, then a decision 312 determines whether there are additional tones to9be processed. When a decision 312 determines that there are additional tonesto be processed, the next tone is selected 314. Following the selection 314 ofthe next tone, the reference subject hearing loss processing 300 returns torepeat the operation 304 and subsequent operations. Alternatively, when adecision 312 determines that there are no more tones to be processed, thereference subject's response is saved 316. After saving 316 the referencesubject's response, the reference subject hearing loss processing 300 iscomplete and ends.

FIG. 4 is a flow diagram of target subject hearing loss processing 400io according to one embodiment of the invention. The target subject hearing lossprocessing 400 is generally similar to the reference subject hearing lossprocessing 300 illustrated in FIG. 3. One notable difference is that the targetsubject hearing loss processing 400 pertains to a particular target subject,whereas the reference subject hearing loss processing 300 pertains to areference subject. The target subject hearing loss processing 400 is, forexample, additional detail on the operations performed with respect to the on-linehearing loss test for the target subject at operation 208 illustrated in FIG. 2.

The target subject hearing loss processing 400 initially provides 402 atarget subject at a local machine. Then, sound is generated 404 at the localmachine for a first tone. A decision 406 then determines whether the targetsubject's response to the sound generated 404 at the local machine has beenreceived. When a decision 406 determines that the target subject's response isnot yet received, the target subject hearing loss processing 400 awaits such aresponse. Once the decision 406 determines that the target subject's responsehas been received, a decision 408 determines whether a next tone should beprocessed. When a decision 408 determines that the next tone should not yetbe processed, then the level of the tone (current tone) is adjusted 41 0. Here, thelevel of the tone is typically adjusted up or down and then the processing returnsto repeat the operation 404 and subsequent operations. On the other hand,when the decision 408 determines that a next tone is to be processed, then adecision 412 determines whether there are additional tones to be processed.

10.hen a decision 412 determines that there are additional tones to be processed,the next tone is selected 414. Following the selection 414 of the next tone, thetarget subject hearing loss processing 400 returns to repeat the operation 404and subsequent operations. Alternatively, when a decision 412 determines thatthere are no more tones to be processed, the target subject's response is saved416. After saving 416 the target subject's response, the target subject hearingloss processing 400 is complete and ends.

Further, with respect to the hearing loss processing 300 and 400, thesounds or tones presented to the subject are, for example,

preferably pureio tones. The local machine generates the sounds (such as with a sound card) andoutputs the sounds to the subject through a speaker, an earphone, or a headset.

It should be noted that the sounds can be specifically generated on-demandfrom the sound card or produced using predetermined sound files. The subject'sresponse (i.e., whether they hear the sound or not) can be input to the localmachine through a wide range of input devices. One input method is throughuse of a mouse and a graphical user interface (see FIG. 7). Typically, for eachtone a reversal sequence is followed. When the subject responds (indicates)that they hear the tone, the level of the tone will be reduced and presented to thesubject again. When the subject responds (indicates) that they cannot hear thetone, the level (i.e., amplitude) of the tone will be increased and presented to thesubject again. This procedure will repeat many times until a certain number ofreversals from decreasing the tone to increasing the tone has been reached,thereby completing the reversal sequence. The levels for the tones can begenerated by particular control of the sound card or by selection of thepredetermined sound file for a given tone and amplitude. The hearing thresholdof the subject is defined as the signal level at which the patient can hear the tone50% percen t of the time the tone is presented to the patient. The hearingthreshold can be derived from the various reversal levels. For each ear, theabove procedure is usually repeated at 125, 250, 500t 1000, 2000, 4000, and3o 8000 Hz. Further, if the difference of the hearing thresholds at two adjacentfrequencies exceeds a critical value (e.g., 20 dB), an additional test can beperformed at a middle frequency. Often middle frequencies are only applied,11when needed, for frequencies between 500 to 8000 Hz. Accordingly, themaximum number of testing frequencies is usually eleven (e.g., 125, 250, 500@750@ 1500, 2000@ 3000, 4000, 6000, and 8000 Hz). From the various responsesprovided, the hearing related parameters are determined. Typically, thesehearing related parameters are threshold levels for the subject's hearing at thevarious frequencies tested.

Instead of the reference subject hearing loss processing 300, thereference subject hearing loss can also be used to adjust audio levels at thelocation machine. Here, a continuous sound (e.g., pulsed or continuous pureio tone) is presented to the reference subject. Then, the reference subject adjuststhe audio sound output such that it is just audible. Such volume adjustment canbe achieved in a variety of ways, such as speaker volume control, volumecontrol displayed on a graphical user interface, or software control. Hence, thisapproach is another way to set the reference hearing level, though it is lessprecise than the reference subject hearing loss processing 300.

FIG. 5A is a flow diagram of on-line sound processing 500 according toone embodiment of the invention. The on-line sound processing 500 providescustomized sound for users over a data network. The sound is customized tothe particular users in accordance to determined hearing losses of such users.

In other words, for a particular user, the on-line sound processing 500 operatesto render generic sound into customized sound that compensates (i.e., makecertain corrections for) the hearing loss of the user.

The on-line sound processing 500 initially performs 502 an on-linediagnosis of hearing loss. The on-line diagnosis of hearing loss is associatedwith a particular user. For example, the on-line diagnosis of hearing loss can bedetermined using the processing as shown in Fig. 2.

After the on-line diagnosis has been performed 502 (or

alternatively thediagnosis is retrieved from a previous determination), a decision 504 determineswhether sound enhancement processing is desired (or requested). When a3o decision 504 determines that sound enhancement processing is not desired,then the on-line sound processing 500 is complete and ends without any sound12enhancement being performed. In this case, the on-line sound processing iseffectively not performed.

On the other hand, when the decision 504 determines that soundenhancement processing is desired (or requested), then an electronic soundsource is identified 506. Here, the electronic sound source could be apredetermined sound source, could be selected by a user operation, or could beautomatically selected by a server (e.g., the hearing assistance server 104illustrated in FIG. 1). Examples of electronic sound sources include audio filessuch as wav files, MP3 files, etc. Next, the electronic sound associated with thelo identified electronic sound source is enhanced 508 to compensate for thehearing loss of the user. Here, the electronic sound is customized tocompensate for the hearing loss of the user. Typically, the sound customization in near real-time or can instead result in a customized audio file that can besaved and played as desired. Thereafter, a decision 512 determines whetherthere is more electronic sound to be processed. When the decision 512determines that there is more electronic sound to be processed, the on-linesound processing 500 returns to repeat the operation 506 and subsequentoperations so that additional electronic sounds can be processed in a similarmanner. Once the decision 512 determines that there is no more electronicsound to be processed, the on-line sound processing 500 is complete and ends.

FIG. 5B is a flow diagram of on-line hearing loss simulation processing550 according to one embodiment of the invention. The on-line hearing losssimulation processing 550 provides a subject the ability to hear sound that has3o been distorted to simulate a hearing loss. This allows persons with normalhearing to hear how sounds will be heard by someone that is hearing impaired.

13.he on-line hearing loss simulation processing 550 initially performs 552an on-line diagnosis of hearing loss. The on-line diagnosis of hearing loss isassociated with a particular user (subject) with hearing loss. For example, theon-line diagnosis of hearing loss can be determined using the processing asshown in FIG. 2. After the on-line diagnosis has been performed 552 (oralternatively the diagnosis is retrieved from a previous determination), a decision554 determines whether hearing loss simulation processing is desired (orrequested). When the decision 554 determines that hearing loss simulation isnot desired, then the on-line hearing loss simulation processing 550 is completeio and ends without any hearing loss simulation being performed. In this case, theon-line hearing loss simulation is effectively not performed.

On the other hand, when a decision 554 determines that hearing losssimulation processing is desired (or requested), then a normal subject isprovided 556 at the local machine if not already at the local machine. Often, thenormal subject has a desire to hear how the impaired subject would hearsounds. An electronic sound source is identified 558. Here, the electronicsound source could be a predetermined sound source, could be selected by auser operation, or could be automatically selected by a server (e.g., the hearingassistance server 104 illustrated in FIG. 1). Examples of electronic soundsources include audio files such as wav files, MP3 files, etc. Next, the electronicsound associated with the identified electronic sound source is degraded 560 tosimulate hearing loss according to the hearing loss identified at operation 552.

Here, the electronic sound is intentionally degraded to allow the subject toexperience an impaired condition. Typically, the sound customization would beperformed at a remote server (e.g., hearing assistant server 104), but could alsobe performed locally on the local machine of the user. Next, the degradedelectronic sound is played 562. The degraded electronic sound can be madeavailable in near real-time or can instead result in a customized audio file thatcan be saved and played as desired. Thereafter, a decision 564 determineswhether there is more electronic sound to be processed. When the decision 564determines that there is more electronic sound to be processed, the on-linesound processing 550 returns to repeat the operation 556 and subsequent14operations so that additional electronic sounds can be processed in a similarmanner. Once the decision 564 determines that there is no more electronicsound to be processed, the on-line hearing loss simulation processing 550 iscomplete and ends.

FIG. 6A - 6D are flow diagrams of hearing assistance processing 600according to one embodiment of the invention. The hearing assistanceprocessing 600 is, for example, processing performed by the hearing assistantserver 104 illustrated in FIG. 1. The hearing assistance processing 600 canperform various tasks, such as hearing evaluations, hearing loss reports,lo referrals, and hearing enhancement simulations, and can perform these tasks invarious orders.

The hearing assistance processing 600 initially performs 602 an on-linediagnosis of hearing loss. Next, a decision 604 determines whether a hearingreport is desired. When the decision 604 determines that a hearing report isdesired, the hearing report can be generated and transmitted 606 to the targetsubject. As an example, the hearing report can indicate where and to whatextent the target subject's hearing is impaired. Alternatively, when the decision604 determines that a hearing report is not desired, the operation 606 isbypassed.

Next, a decision 608 determines whether the target subject's hearing isimpaired. When the decision 608 determines that the target subject's hearing isnot impaired (i.e., normal hearing), then the target subject is advised 610 that ahearing aid is not recommended. Thereafter, the hearing assistance processing600 is complete and ends.

On the other hand, when the decision 608 determines that the targetsubject's hearing is impaired, then the target subject is advised 612 that ahearing aid is recommended. As this point, the hearing assistance processing600 can provide additional assistance to the target subject to assist the targetsubject in obtaining a hearing aid or other hearing assistance product or service.

3. As will be discussed below, the additional assistance can inform the targetsubject of available hearing aid types, permit on-line simulation of sounds,15enable the target subject to be referred to a hearing aid product or serviceprovider, allow on-line purchase of a hearing aid, schedule an appointment witha hearing aid product or service provider, or store hearing loss information forsubsequentuse.

According to one embodiment, the hearing assistance processing 600presents 614 the target subject with available hearing aid types. A decision 616then determines whether the target subject has selected one of the availablehearing aid types. When a decision 616 determines that the target subject hasmade a selection, then the hearing assistance processing 600 determines 618io hearing aid parameters for the target subject. In one implementation, thehearing aid parameters can be specific to the selected hearing aid types. Inanother implementation, the hearing aid perimeters can

be generic to varioushearing aid types.

Next, a decision 620 determines whether the target subject desires toperform an on-line simulation. When the decision 620 determines that the targetsubject does desire on-line simulation, then on-line simulation of sounds withhearing aid processing is performed 622. Here, the on-line simulation enhancesthe sound for the target subject based on one or both of the selected hearing aidtype and the target subject's hearing loss. A decision 624 then determineswhether the hearing aid parameters are to be adjusted. The decision 624 can beinitiated either automatically or by the target subject's request. In either case,when the decision 624 determines that the hearing aid parameters are to beadjusted, the parameters for hearing aid processing are adjusted 626. Here, theadjustments can be controlled by the target subject or automatically by a server(e.g., the hearing assistant server 104). Thereafter, the hearing assistanceprocessing 600 returns to repeat the operation 622 and subsequent block so thatthe on-line simulation can continue with the adjusted parameters.

Alternatively, when the decision 624 determines that the hearing aidparameters are not to be adjusted, then a decision 628 determines whether thetarget subject desires to select another hearing aid type. By providing the targetsubject the ability to select various different hearing aid types and simulate their16operation, the target subject is able to evaluate the different hearing aid typesand have some basis to make a selection among them. When a decision 628determines that the target subject does select another hearing aid type, then thehearing assistance processing 600 returns to repeat the operation 614 andsubsequent blocks so that the user is able to select another available hearing aidtype and perform an on-line simulation. On the other hand, when a decision 628determines that the target subject does not desire to selected another hearingaid type, then the hearing assistance processing 600 can select or recommend630 one or more suitable hearing aids for the target subject. The selection orio recommendation can be influenced by feedback received from the target subject.

As an example, feedback can be obtained through a questionnaire presentedand completed by the target subject. Following operation 630, the on-linesimulation is completed. Also, when the decision 620 determines that the targetsubject does not desire on-line simulation, the operations 622-630 are bypassed.

Further, the hearing assistance processing 600 can determine whether anon-line purchase of a hearing aid is desired. A decision 631 determines whetherthe target subject desires to purchase a hearing aid on-line. When the decision631 determines that an on-line purchase is not desired, then the hearingassistance processing 600 can operate to determine whether a referral is2o desired. Here, a decision 632 determines whether the target subject desires toreceive a referral to a suitable hearing aid product or service provider. When thedecision 632 determines that a referral is desired, then the target subject ispresented 634 with a list of suitable hearing aid product or service providers.

Then, a decision 636 determines whether the target subject has selected one ofthe hearing aid product or service providers. Once the decision 636 determinesthat the target subject has selected one of the hearing aid product or serviceproviders, then a decision 638 determines whether the target subject desires tomake an appointment with the selected product or service provider. When thedecision 638 determines that an appointment is to be made, the appointment isscheduled 640. The appointment can be scheduled on-line such as over theInternet or through use of electronic mail. Following the scheduling 640 of theappointment, as well as directly

following the decision 638 when an appointment17is not to be made, the referral processing is completed. Also, when the decision632 determines that the referral is not desired, the operations 634 - 640 arebypassed.

Still further, the hearing assistance processing 600 can operate to causethe hearing loss information of the target subject to be saved 642. The hearingloss information can be saved in a variety of locations depending upon the typeof hearing loss information and how it might be used. For example, the hearingloss information could be stored on the hearing assistant server 104 illustrated inFIG. 1 or some other remote server device or associated database that can beio accessed via the data network 102. By saving the hearing loss information,comparative studies can be performed, or users can compare a subsequenthearing loss diagnosis with prior ones. Also, by saving the hearing lossinformation, the hearing loss information can be accessed as need to performon-line simulations or to produce hearing aids or other hearing correctionproducts or services.

Next, a decision 644 determines whether a hearing loss informationshould be forwarded. Typically, the hearing loss information would be forwardedto the selected product or service provider so that the product or service providercan thereafter utilize the hearing loss information that has been obtained andperhaps modifications thereto made using on-line simulations. In any case,when the decision 644 determines that the hearing loss information should beforwarded, then the hearing loss information is transmitted 646 to the selectedhearing aid service provider. After the hearing loss information has beentransmitted 646, as well as directly following the decision 644 when the hearingloss information is not be forwarded, the hearing assistance processing 600 iscomplete and ends.

Still further, when the decision 631 determines that the target subjectdoes desire to purchase a hearing aid on-line, the hearing assistance processing600 performing the operation shown in FIG. 6D to effectuate an on-linepurchase. Namely, since a hearing aid has presumably already be selected,payment and shipping information are entered 648. The target subject can, for18example, enter this information at the local machine. Then, the hearing aidselection, payment, and shipping information are confirmed 650. To the extentthat such information is not already known, it can be entered by the targetsubject. Next, a hearing-aid provider physically programs 652 a hearing aiddevice (of the selected hearing aid type) in accordance with the hearing aidparameters previously determined. The target subject may or may not havecaused adjustment of the hearing aid parameters, such as through on-linesimulation. For future reference, the hearing aid, hearing loss, simulation andshipping information can be saved 654. After the programming 652 of theio hearing aid device, the hearing aid device is shipped 656 to the target subject (orother person making the purchase).

In one embodiment, the hearing assistance rocessing 600 is performedpby a server, such as the hearing assistant server 104 illustrated in FIG. 1.

However, the hearing assistance processing 600 is also influenced by user input.

For example, the subject can indicate whether a hearing report is desired orwhether on-line simulation is desired. As other examples, the subject can alsoinfluence the hearing assistance processing 600 by selection of hearing aidtypes or service providers. In another embodiment, portions of the hearingassistance processing 600 can by performed on the local machine.

To further illustrate the hearing assistance processing 600, consider thefollowing example. Here, assume that the on-line diagnosis of hearing loss thatis performed (602) yields the following hearing thresholds for a subject.

50.2000 30000 402000 504000 608000 7019Given that the subject suffers from impaired hearing, the subject selects(616) a hearing aid type. The hearing aid parameters for the selected hearingaid type are then determined (618). Typically, the determination of the hearingaid parameters is dependent on the type of hearing parameter and often on theparticular manufacturer. For this example, assume that the following hearing aidparameters are determined for the selected hearing aid type.

50.500 10 5000 20 102000 25 134000 30 158000 30 15Here the hearing aid parameters include various soft-sound gains and loud-lo sound gains for various frequencies. The soft-sound gains are used for softerincoming sounds, while the loud-sound gains are for louder incoming sounds.

Assume then that on-line simulation is performed (622) and that thehearing aid parameters are adjusted (626). As a result, the hearing aidparameters after adjustment are then as follows.

81322000.27 154000 34 188000 18L@@P@Note, that adjustments to the hearing aid parameters as compared to thoselisted above. Hence, the subject or server are able to adjust the hearing aid20parameters, or more generally the on-line simulation, to experiment with differentadjustments and perhaps improve their listening quality or experience.

FIG. 7 is a screen depiction of a user interface for a local machine. In thisexample, a network browser (i.e., Microsoft Internet Explorer) displays a screenthat allows a subject to take an on-line hearing test as well as display results ofthe on-line hearing test. The screen 700 indicates various test frequencies onwhich the hearing test is performed, the ear to be tested, whether the subject is areference subject or a target subject. As shown, for each of the test frequencies,a reference in decibels is determined using the reference subject, and thresholdio hearing levels for left and right ears are determined for the target subject. Thescreen 700 also illustrates several buttons to allow a user to control the on-linehearing test. Typically, the sound will be coming from the server to the clientwhere it is played on speakers or a headset to the user. The screen 700 depictsa start button to start the on-line hearing test, a pause button to pause the on-line hearing test, a stop button to stop the on-line hearing test, a response yesbutton (RespYes), a response no button (RespNo), and a reset test button(ResetTest).

Although the relative hearing loss evaluation processing 200 shown inFIG. 2 and the reference subject hearing loss processing 300 shown in FIG. 3make use of a reference subject, other embodiments can provide hearing lossdiagnosis without using a reference subject. FIG. 8 is a block diagram ofcalibration-based hearing loss evaluation processing 800 according to oneembodiment of the invention. The calibration-based hearing loss evaluationprocessing 800 calibrates a sound generating device instead of relying on areference subject.

The calibration-based hearing loss evaluation processing 800 initiallyconducts 802 calibration processing for an on-line hearing testing system toobtain calibration parameters. The on-line hearing testing system is, forexample, the network-based hearing evaluation and compensation system 1 00illustrated in FIG. 1, namely, the local machine 108 thereof. After the calibrationparameters have been determined, a target subject is provided 804 at a local21machine. The local machine is, for example, a personal computer having anetwork browser thereon. Next, an on-line

hearing loss test is performed 806with the target reference subject at the local machine. As noted above, theparticulars of hearing loss tests, such as tone frequency and amplitude, aregenerally well known in the art. However, according to the invention, the hearingloss test is performed on-line. As an example, the on-line hearing loss test canbe controlled by the hearing assistant server 104 illustrated in FIG. 1 such thatthe target subject positioned proximate to the local machine 106 or 108 canreceive sound signals associated with the hearing loss test and respond them atlo the local machine. The on-line hearing loss test establishes target parameters.

In one embodiment, the target parameters are hearing loss levels. Thereafter,hearing loss of the target subject can be determined 808 based on the targetparameters and the calibration parameters. In one embodiment, the hearingloss is expressed as various hearing thresholds for different frequencies. Afterthe hearing loss has been determined 808, the calibration-based hearing lossevaluation processing 800 ends. Note that the calibration-based hearing lossevaluation processing 800 does not require any special purpose hardware,merely a local machine (e.g., personal computer having a network browser withaccess to a data network) and an audio component (e.g., sound card andspeaker).

FIG. 9 is a flow diagram of calibration processing 900 according to oneembodiment of the invention. The calibration processing 900 is, for example,performed by the calibration processing of operation 802 in FIG. 8. Initially, asubject is provided 902 at the local machine. The subject can have normal orimpaired hearing. Next, a calibration sound is played 904 at the local machine.

At the same time, a reference sound is played 906 from a calibration device.

Typically, the calibration device is separate from the local machine and serves toproduce the reference sound. The reference sounds produced by the calibrationdevice are known. As an example, a calibration device can generate a referencesound (e.g., a pure tone) at certain levels and have an on-off mechanism.

Further, since for accurate calibration, the calibration device has to be used in amanner such that sound level at the subject's ears is known. Namely, in one22implementation, the subject can be instructed to hold the calibration device one(1) foot in front of one's nose. The calibration device can be a special purposedevice designed for the very purpose of generating the reference sound.

Alternatively, the calibration object could be any object capable of reliablyemitting a sound at a substantially known level.

Once the calibrating sound and the reference sound are played 904 and906, a decision 908 determines whether the calibrating sound is louder to thesubject that the reference sound. If the decision 908 determines that thecalibrating sound is louder than the reference sound, then the calibrating soundio is decreased 91 0. Alternatively, when the decision 908 determines that thecalibrating sound is not louder than the reference sound, then a decision 912determines whether the calibrating sound is softer than the reference sound.

When the decision determines that the calibrating sound is softer than thereference sound, then the calibrating sound is increased 914. Such adjustmentsto the sound can be achieved in a variety of ways, such as speaker volumecontrol, volume control displayed on a graphical user interface, or softwarecontrol. Following the decreasing 91 0 or the increasing 914 to the calibratingsound, the calibration processing 900 returns to repeat the operation 904 andsubsequent operations. On the other hand, once the decision

determines thatthe calibrating sound is not softer than the reference sound, the calibrationparameters have been determined. Hence, the calibration parameters are saved916 and the calibration processing 900 is complete and ends.

The invention is preferably implemented in software, but can beimplemented in hardware or a combination of hardware and software. Theinvention can also be embodied as computer readable code on a computerreadable medium. The computer readable medium is any data storage devicethat can store data which can be thereafter be read by a computer system.

Examples of the computer readable medium include read-only memory, random-access memory, CID-ROMs, magnetic tape, optical data storage devices, carrierwaves. The computer readable medium can also be distributed over a network23coupled computer systems so that the computer readable code is stored andexecuted in a distributed fashion.

The advantages of the invention are numerous. Different embodiments orimplementations may yield one or more of the following advantages. Oneadvantage of the invention is that hearing tests are able to be performed on-line.

Another advantage of the invention is that no expensive specialized equipmentor personnel is needed for performing hearing tests. Another advantage of theinvention is that near real-time sound customization can be performed. Stillanother advantage of the invention is that on-line simulation of hearing aidio processing can be performed. Such on-line simulation can include deriving a setof fitting parameters from an on-line diagnosis and then playing backcompensated sound. Yet another advantage of the invention is that oncehearing loss is diagnosed, proper hearing aids can be recommended and/orpurchased on-line, and/or referrals can be made to suitable service or productproviders. Still yet another advantage of the invention is that the data obtainedfrom the hearing tests can be archived for later usage or forwarded to suitableservice or product providers.

The many features and advantages of the present invention are apparentfrom the written description and, thus, it is intended by the appended claims tocover all such features and advantages of the invention. Further, sincenumerous modifications and changes will readily occur to those skilled in the art,it is not desired to limit the invention to the exact construction and operation asillustrated and described. Hence, all suitable modifications and equivalents maybe resorted to as falling within the scope of the invention.

First Claim: Show all claims

24. method for determining an amount of hearing loss for a participatingsubject, said method comprising the acts of:(a) performing a first on-line hearing loss test for a reference subject toproduce reference parameters;(b) performing a second on-line hearing loss test for the participatingsubject to produce participant parameters; and(c) determining relative hearing loss for the participating subject based onthe participant parameters and the reference parameters.

Other Abstract Info: none

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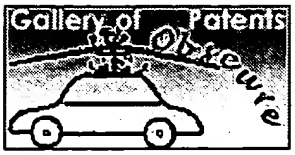

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Abstract: Improved approaches to assist those having hearing loss are disclosed. One approach pertains to providing on-line hearing loss testing. The on-line hearing loss testing can be self-performed without any specialized equipment. Another approach pertains to on-line sound customization. The sound customization can simulate hearing compensation on-line. As an example, the hearing compensation can be used to simulate hearing aid processing. Still another approach pertains to a recommendation and/or referral procedure.
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Family: Show known family members

Description: Expand full description

+ METHOD AND SYSTEM FOR ON-LINEHEARING EXAMINATION AND CORRECTION
+ BACKGROUND OF THE INVENTION
+ DESCRIPTION OF THE RELATED ART
+ SUMMARY OF THE INVENTION
+ BRIEF DESCRIPTION OF THE DRAWINGS
+ DETAILED DESCRIPTION OF THE INVENTION

Claims:
[Hide claims]:

24. method for determining an amount of hearing loss for a participatingsubject, said method comprising the acts of:(a) performing a first on-line hearing loss test for a reference subject toproduce reference parameters;(b) performing a second on-line hearing loss test for the participatingsubject to produce participant parameters; and(c) determining relative hearing loss for the participating subject based onthe participant parameters and the reference parameters.

2.A method as recited in claim 1, wherein said method further comprises:(d) providing a hearing loss report to the participating subject inaccordance with the relative hearing loss.

3.A method as recited in claim 1, wherein said performing (a) and (b) of thefirst and second on-line hearing loss tests are performed on a local machine.2o 4. A method as recited in claim 3, wherein the local machine is a computingdevice.

5.A method as recited in claim 3, wherein the local machine is a personalcomputer.

6.A method as recited in claim 1 , wherein said determining (c) of the relativehearing loss is performed at a web server, and wherein the local machinecommunicates with web server over a data network.3o 7. A method as recited in claim 6, wherein the data network is the Internet.25. A method as recited in claim 1, wherein said performing (a) and (b) of thefirst and second on-line hearing loss tests are performed on a local machine butcontrolled by the web server.

9.A method as recited in claim 1, wherein said method further comprises:(d) informing the participating subject that they suffer from a hearingimpairment based on the relative hearing loss.

10.A method as recited in claim 1 , wherein said method further comprises:(d) recommending on-line that the participating subject obtain a hearingassistance device when the relative hearing loss indicates a significant hearingimpairment.

11.A method as recited in claim 10, wherein said method further comprises:(e) simulating enhanced hearing of the hearing assistance device to theparticipating subject.

12.A method as recited in claim 1 1 , wherein said simulating (e) is on-linesimulating.

13.A method as recited in claim 1 , wherein said method further comprises:(d) presenting a list of available hearing aid types to the participatingsubject when the relative hearing loss indicates a significant hearing impairment.

14.A method as recited in claim 13, wherein said method further

comprises:(e) simulating a selected one of the available hearing aid types to theparticipating subject.

15.A method as recited in claim 14, wherein said simulating (e) is on-linesimulating.26. A method as recited in claim 14, wherein said simulating (e) allows theparticipating subject to adjust parameters associated with the selected one of theavailable hearing aid types.

17.A method as recited in claim 1 , wherein said method further comprises:(d) simulating hearing impairment of the participating subject to anothersubject in accordance with the relative hearing loss of the participating subject.

18.A method as recited in claim 17, wherein said simulating (d) is on-linelo simulating.

19.A method as recited in claim 1, wherein said method further comprises:(d) simulating enhanced hearing to the participating subject, the enhancedhearing compensates for the relative hearing loss of the participating subject.

20.A method as recited in claim 19, wherein said simulating (d) is on-linesimulating.

21.A method as recited in claim 1, wherein said method further comprises:(d) computerized simulating of a plurality of hearing assistance deviceswhich enhance hearing to the participating subject by compensating for therelative hearing loss of the participating subject.

22.A method as recited in claim 21, wherein said method further comprises:(e) ranking the hearing assistance devices examined during saidcomputerized simulating (d).

23.A method as recited in claim 1, wherein said method further comprises:(d) referring on-line the participating subject to a hearing aid product orservice provider.

24.A method as recited in claim 1 , wherein said method further comprises:27(d) comparing the relative hearing loss with an impairment threshold; and(e) referring on-line the participating subject to a hearing aid product orservice provider when said comparing (d) indicates that the relative hearing lossexceeds the impairment threshold.

25.A method as recited in claim 1 , wherein said method further comprises:(d) comparing the relative hearing loss with an impairment threshold; and(e) recommending a hearing aid product or service provider when saidcomparing (d) indicates that the relative hearing loss exceeds the impairmentio threshold.

26.A method as recited in claim 1, wherein said method further comprises:(d) comparing the relative hearing loss with an impairment threshold; and(e) on-line simulating enhanced hearing of a hearing assistance device tothe participating subject when said comparing (d) indicates that the relativehearing loss exceeds the impairment threshold.

27.An on-line method for providing hearing aid processing, said on-linemethod comprising the acts of:performing an on-line diagnosis of a user's hearing loss;determining hearing aid parameters based on the on-line diagnosis;modifying an electronic sound source based on the hearing aidparameters to produce a modified electronic sound source; andplaying the modified electronic sound source for the user.

28.An on-line method as recited in claim 27, wherein the electronic soundsource is provided at a web server, andwherein said performing of the on-line diagnosis uses at least a localcomputer at the user's location.28. An on-line method as recited in claim 28, wherein said performing of the.on-line diagnosis includes at least transmitting predetermined sound signal to theuser's computer over a data network.

30.An on-line method as recited in claim 27, wherein said playing comprises:transmitting the modified electronic sound source to a local computer atthe user's location over a data network; andplaying the modified electronic sound source at the local machine.io 31. An on-line method for providing hearing aid processing, said on-linemethod comprising the acts of:receiving hearing loss data on-line for a user;determining hearing aid parameters based on the hearing loss data;modifying an electronic sound source based on the hearing aidparameters to produce a modified electronic sound source; andplaying the modified electronic sound source for the user.

32.A method as recited in claim 31, wherein said method further comprisesthe act of:allowing on-line adjustment to the hearing aid parameters by the user.

33.An on-line method as recited in claim 31, wherein said playing comprises:transmitting the modified electronic sound source to a local computer atthe user's location over a data network; andplaying the modified electronic sound source at the local machine.

34.A method for referring a hearing impaired listener to a hearing product orservice specialist, said method comprising the acts of:receiving hearing loss data on-line for a hearing impaired user;receiving a selection of one of a plurality of hearing product or serviceproviders;29directing the hearing impaired listener to the selected one of the hearingproduct or service providers; andforwarding the hearing loss data for the hearing impaired listener to theselected one of the hearing product or service providers over a data network.

35.A method as recited in claim 34, wherein said method further comprisesthe act of:scheduling an appointment on-line with the selected one of the hearingproduct or service providers for the hearing impaired listener.

36.A method as recited in claim 34, wherein said method further comprisesthe act of:simulating enhanced hearing for the hearing impaired listener, theenhanced hearing compensates for the determined hearing loss of the hearingimpaired listener.

37.A method as recited in claim 34, wherein said receiving of the hearingloss data comprises:determining hearing loss of the hearing impaired listener on-line, the2o hearing loss being represented in the hearing loss data.

38.A method as recited in claim 37, wherein said method further comprisesthe act of:scheduling an appointment on-line with the selected one of the hearingproduct or service providers for the hearing impaired listener.

39.A method as recited in claim 37, wherein said method further comprisesthe act of:simulating enhanced hearing for the hearing impaired listener, the3o enhanced hearing compensates for the determined hearing loss of the hearingimpaired listener.30. A method as recited in claim 39, wherein said method further comprisesthe act of:purchasing a hearing aid product on-line based on the hearing loss data.

41.A method as recited in claim 34, wherein said method further comprisesthe act of:purchasing a hearing aid product on-line based on the hearing loss data.

42.An on-line method for providing impaired hearing simulation, said on-lineio method comprising the acts of:receiving hearing loss data on-line for a first user, the first user beinghearing impaired;modifying an electronic sound source based on the hearing less data toproduce an impaired electronic sound source; andplaying the impaired electronic sound source for second user, the seconduser being substantially non-hearing impaired.

43.A computer readable medium including computer program code fordetermining an amount of hearing loss for a participating subject, said computer2o readable medium comprising:computer program code for performing a first on-line hearing loss test fora reference subject to produce reference parameters;computer program code for performing a second on-line hearing loss testfor the participating subject to produce participant parameters; andcomputer program code for determining relative hearing loss for theparticipating subject based on the participant parameters and the referenceparameters.

44.A computer readable medium including computer program code forproviding on-line hearing aid processing, said computer readable mediumcomprising:31computer program code for accessing an on-line diagnosis of a user'shearing loss;computer program code for determining hearing aid parameters based onthe on-line diagnosis;computer program code for modifying an electronic sound source basedon the hearing aid parameters to produce a modified electronic sound source;andcomputer program code for transmitting the modified electronic soundsource for the user.

45.A computer readable medium including computer program code forreferring a hearing impaired listener to a hearing product or service specialist,said computer readable medium comprising:computer program code for determining hearing loss of the hearingimpaired listener on-line, the hearing loss being represented in hearing loss data;computer program code for receiving a selection of one of a plurality ofhearing product or service providers;computer program code for directing the hearing impaired listener theselected one of the hearing product or service providers; andcomputer program code for forwarding the hearing loss data for thehearing impaired listener to the selected one of the hearing product or serviceproviders over a data network.

46.A method for determining an amount of hearing loss for a participatingsubject, said method comprising the acts of:(a) performing a calibration process on a local machine to producecalibration parameters;(b) performing an on-line hearing loss test for the participating subject atthe local machine to produce participant parameters; and(c) determining hearing loss for the participating subject based on theparticipant parameters and the calibration parameters.32. A method as recited in claim 46, wherein said method further comprises:(d) providing a hearing loss report to the participating subject inaccordance with the hearing loss.

48.A method as recited in claim 46, wherein the local machine is a computingdevice.

49.A method as recited in claim 46, wherein the local machine is a personalcomputer.

50.A method as recited in claim 46, wherein said determining (c) of thehearing loss is performed at a web server, and wherein the local machinecommunicates with web server over a data network.

51.A method as recited in claim 50, wherein the data network is the Internet.

52.A method as recited in claim 46, wherein said method further comprises:(d) informing the participating subject that they suffer from a hearingimpairment based on the hearing loss.

53.A method as recited in claim 46, wherein said method further comprises:(d) presenting a list of available hearing aid types to the participatingsubject when the hearing loss indicates a significant hearing impairment.

54.A method as recited in claim 46, wherein said method further

comprises:(d) recommending on-line that the participating subject obtain a hearingassistance device when the hearing loss indicates a significant hearingimpairment.3o 55. A method as recited in claim 54, wherein said method further comprises:(e) simulating enhanced hearing of the hearing assistance device to theparticipating subject.33. A method as recited in claim 55, wherein said simulating (e) is on-linesimulating.

57.A method as recited in claim 56, wherein said simulating (e) allows theparticipating subject to adjust parameters associated with the selected one of theavailable hearing aid types.

58.A method as recited in claim 46, wherein said method further comprises:(d) simulating enhanced hearing to the participating subject, the enhancedhearing compensates for the hearing loss of the participating subject.

59.A method as recited in claim 58, wherein said simulating (d) is on-linesimulating.

60.A method as recited in claim 46, wherein said method further comprises:(d) simulating hearing impairment of the participating subject to anothersubject in accordance with the hearing loss of the participating subject.2o 61. A method as recited in claim 60, wherein said simulating (d) is on-linesimulating.

62.A method as recited in claim 46, wherein said method further comprises:(d) computerized simulating of a plurality of hearing assistance deviceswhich enhance hearing to the participating subject by compensating for thehearing loss of the participating subject.

63.A method as recited in claim 46, wherein said method further comprises:(d) referring on-line the participating subject to a hearing aid product orservice provider.34. A computer readable medium including computer program code fordetermining an amount of hearing loss for a participating subject, said computerreadable medium comprising:computer program code for performing a calibration process on a localmachine to produce calibration parameters;computer program code for performing an on-line hearing loss test for theparticipating subject at the local machine to produce participant parameters; andcomputer program code for determining hearing loss for the participatingsubject based on the participant parameters and the calibration parameters.

65.A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:computer program code for providing a hearing loss report to theparticipating subject in accordance with the hearing loss.

66.A computer readable medium as recited in claim 64, wherein saidcomputer program code for determining the hearing loss is performed at a webserver, and wherein the local machine communicates with web server over adata network.

67.A computer readable medium as recited in claim 66, wherein the datanetwork is the Internet.

68.A computer readable medium as recited in claim 64, wherein saidComputer readable medium further comprises:computer program code for informing the participating subject that theysuffer from a hearing impairment based on the hearing loss.

69.A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:35computer program code for presenting a list of available hearing aid typesto the participating subject when the hearing loss indicates a significant hearingimpairment.

70.A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:computer program code for referring on-line the participating subject to

ahearing aid product or service provider.lo 71. A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:computer program code for recommending on-line that the participatingsubject obtain a hearing assistance device when the hearing loss indicates asignificant hearing impairment.

72.A computer readable medium as recited in claim 71, wherein saidcomputer readable medium further comprises:computer program code for on-line simulating enhanced hearing of thehearing assistance device to the participating subject.

73.A computer readable medium as recited in claim 72, wherein saidcomputer program code for simulating allows the participating subject to adjustparameters associated with the selected one of the available hearing aid types.

74.A computer readable medium as recited in claim 72, wherein saidcomputer readable medium further comprises:computer program code for referring on-line the participating subject to ahearing aid product or service provider.3o 75. A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:36computer program code for on-line simulating enhanced hearing to theparticipating subject, the enhanced hearing compensates for the heari.ng loss ofthe participating subject.

76.A computer readable medium as recited in claim 75, wherein saidcomputer readable medium further comprises:computer program code for referring on-line the participating subject to ahearing aid product or service provider.io 77. A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:computer program code for computerized simulating of a plurality ofhearing assistance devices which enhance hearing to the participating subject bycompensating for the hearing loss of the participating subject.

78.A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:computer program code for referring on-line the participating subject to ahearing aid product or service provider.

79.A computer readable medium as recited in claim 64, wherein saidcomputer readable medium further comprises:computer program code for simulating hearing impairment of theparticipating subject to another subject in accordance with the hearing loss of theparticipating subject.37100HEARING LOCALASSISTANT MACHINESERVER1041 1cnccocn--i=ic--im 102cnmmm DATAiNETWORKXcr@mK)HEARING AID LOCALSERVICE MACHINEPROVIDER114- I IFIG. 1/13200.4,)PROVIDE REFERE NCE SUBJECT ATLOCAL MACHINE 2021 -PERFORM ON-LINE HEARING LOSS TESTWITH REFERENCE SUBJECT AT THE LOCAL 204MACHINE TO ESTABLISH REFERENCEPARAMETERSPROVIDE TARGET SUBJECT 206AT LOCAL MACHINEIPERFORM ON-LINE HEARING LOSS TESTWITH TARGET SUBJECT AT THE LOCAL 208MACHINE TO OBTAIN TARGET PARAMETERSDETERMINE HEARING LOSS OF TARGETSUBJECT BASED ON THE TARGET 21 0PARAMETERS AND THE REFERENCEPARAMETERSFIG. 2SUBSTITUTE SHEET (RULE 26)/13300PROVIDE REFERENCE SUBJECT 302AT LOCAL MACHINEGENERATE SOUND AT LOCAL MACHINEFOR FIRST (NEXT) TONE304:306EFE EE C T'SONSE310UST LEVEL OF TONE308XT NE314 ? YESSELECT NEXT TONE312ONESSAVE REFERENCE SUBJECT'S RESPONSE 316FIG. 3SUBSTITUTE SHEET (RULE 26)/13400PROVIDE TARGET SUBJECT 402AT LOCAL MACHINEGENERATE SOUND AT LOCAL MACHINEFOR FIRST

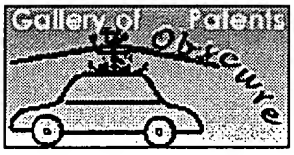
(NEXT) TONE404406@-
UFIVFTARGETSUBJECT'SRESPONSE410ESADJUST
LEVEL OFTONE408XTNE414 ?ESSELECT NETONE412YE
sNOSAVE TARGET SUBJECT'S RESPONSE 416FIG.
4SUBSTITUTE SHEET (RULE 26)/13500PERFORMS ON-LINE
DIAGNOSIS OF HEARING
502LOSS504SOUNDHANCEMEkjROCESSI,YESIDENTIFY
ELECTRONIC SOUND SOURCE rN,,, 506ENHANCE
ELECTRONIC SOUND TO "'508COMPENSATE FOR
HEARING LOSSI -PLAY ENHANCED ELECTRONIC SOUND
rN@@ 510512YNOFIG. 5ASUBSTITUTE SHEET (RULE
26)/13550PERFORMS ON-LINE DIAGNOSIS OF HEARING
'@@ 552LOSS554HFAKINLOSSIMULATI
NOYESPROVIDE SUBJECT AT LOCAL MACHINE
556TIDENTIFY ELECTRONIC SOUND SOURCE
55@TDEGRAGE ELECTRONIC SOUND TOSIMULATE
HEARING LOSS 5601PLAY DEGRADED ELECTRONIC SOUND
562564NOFIG. 513SUBSTITUTE SHEET (RULE
26)/13600PERFORMS ON-LINE DIAGNOSIS OF HEARING
LOSS 602604YES606 GENERATE AND TRANSMIT
HEARINGREPORT TO TARGET SUBJECT608MPAIRED 610?
0 ?ADVISE TARGET SUBJECT612 THAT HEARING AID IS?
NOT RECOMMENDEDADVISE TARGET SUBJECTTHAT
HEARING AID
ISRECOMMENDEDPRESENTTARGETSUBJECTWITH
r,@614AVAILABLE HEARING AID TYPES616618?
ESDETERMINE HEARING AID PARAMETERSFIG.
6ASUBSTITUTE SHEET (RULE 26)/13620N-
LINEIMULATIOYESPERFORM ON-LINE SIMULATION OF
SOUNDS622 WITH HEARING AID PROCESSING624626
PARAM ERSADJUST PARAMETERSFOR HEARING AID
NPROCESSING628NHEARINGAID TYPENSELECT OR
RECOMMEND ONE OR MORE630 SUITABLE HEARING AID(S)
631ON-ILINEFIG. 613SUBSTITUTE SHEET (RULE
26)/13632RESII REDPRESENTTARGETSUBJECTWITHLISTOF
r@\,634SUITABLE HEARING AID SERVICE PROVIDERS6EI
RES640INT?0 SCHEDULE APPOINTMENTSAVE HEARING
LOSS INFORMATION642 OF TARGET SUBJECT646644 ?R
TRANSMIT HEARING LOSSNFORMAT INFORMATION TO?
SELECTED HEARING AIDSERVICE PROVIDERFIG.
6CSUBSTITUTE SHEET (RULE 26)/13ENTER PAYMENT AND
SHIPPING 648INFORMATION650CONFIRM HEARING AID
SELECTION, rN@PAYMENT, AND SHIPPING
INFORMATIONIPROGRAM SELECTED HEARING AID 652WITH
HEARING AID PARAMETERS654SAVE HEARING AID,
HEARING LOSS rN@SIMULATION, AND SHIPPING
INFORMATIONISHIP HEARING AID DEVICE rN@ 656FIG.
6DSUBSTITUTE SHEET (RULE 26)File Ed it View Favorites
Tools Help'=3==, @ F1Back Forward Refresh Me Saearch
@ HCist'ory P15intAddressCnC On-Line Hearing TestcoCnI
Subject: Reference 0 Subject=iC Test Ear(s): 0 Left 0 Right*
BothImCn Test Frequency (Hz) 0250 0500
0750010000150002000030000400006000008000mm Reference
(dB): F4U-1 1135___@ F3 -i F3 1 LIED F3 _I F31 1 F3 _I DT7
F35_Jm--IThreshold (Left, dB, HQ: F___1 E___I F-D F__1 F-7
E___I E__] E--1XCr@ Threshold (Right, dB, HQ:mK) I RespYes
RespTestC@700FIGm 7/13800CONDUCT CALIBRATION
PROCESSINGFOR THE ON-LINE HEARING TESTING
802SYSTEM TO OBTAIN
CALIBRATIONPARAMETERSPROVIDE TARGET SUBJECT
804AT LOCAL MACHINEPERFORM ON-LINE HEARING

LOSSTEST WITH TARGET SUBJECT AT 806THE LOCAL MACHINE TO OBTAINTARGET PARAMETERSDETERMINE HEARING LOSS OFTARGET SUBJECT BASED ON THE 808TARGET PARAMETERS AND THECALIBRATION PARAMETERSFIG. 8SUBSTITUTE SHEET (RULE 26)/13'0@ 9"PROVIDE A SUBJECT (NORMAL OR 902IMPAIRED) AT LOCAL MACHINEd4.40IFPLAY CALIBRATING SOUND `\-904AT LOCAL MACHINEPLAY REFERENCE SOUND FROM A r@\- 906SEPARATE CALIBRATION DEVICE910908CALIB I YES DECREASEUNDLOUDERTHA CALIBRATINGEFERENCE SOUNDSOUND?Is 914912IBRAT YES INCREASEOUND SOFTER TH CALIBRATINGEFERENC SOUNDOUND? NOALIBRATION PARAMETERS 916FIG. 9SUBSTITUTE SHEET (RULE 26)INTERNATIONAL SEARCH REPORT Internation Application NoPCT/US 01/02331A. CLASSIFICATION OFSUBJECT MATTERIPC 7 A61135/12According to International Patent Classification (IPC) orto both national classification and IPCB. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)IPC 7 A61B H04RDocumentation searched other than minimum documentation to the extent that such documents are included in the fields searchedElectronic data base consulted during the international search (name of data base and, where practical, search terms used)EPO-Internal, WPI DataC. DOCUMENTS CONSIDERED TO BE RELEVANTCategory Citation of document, with indication, where appropriate, of the relevant passages Relevant lo claim No.X US 4 284 847 A (R. BESSERMAN 1-599@18 August 1981 (1981 18) 43946-49252264,65268column 1. line 49 -column 3, line 10column 5, line 59 -column 10, line 39Y US 5 928 160 A (R. L. CLARK ET AL 1-9943927 July 1999 (1999 27) 46-52 264-68column 2, line 17 -column 5, line 38Further documents are listed in the continuation of box C. Patent family members are listed in annex.Special categories of cited documents: 'T' later document published after the international filing dateor priority date and not in conflict with the application butW document defining the general state of the art which is not cited lo understand the principle or theory underlying theconsidered to be of particular relevance invention2E5 earlier document but published on or after the international W document of particular relevance; the claimed inventionfiling date cannot be considered novel or cannot be considered to'L' document which may throw doubts on priority claim(s) or involve an inventive step when the document is taken alonewhich is cited to establish the publication date of another nY' document of particular relevance; the claimed inventioncitation or other special reason (as specified) cannot be considered to involve an inventive step when the'O' document referring to an oral disclosure, use, exhibition or document is combined with one or more other such docu-other means ments, such combination being obvious to a person skillednP* document published prior to the international filing date but in the art.later than the priority date claimed W document member of the same patent familyDate of the actual completion of the international search Date of mailing of the international search report20 June 2001 27/06/2001Name and mailing address of the ISA Authorized officerEuropean Patent Office, P.B. 5818 Patentlaan 2NL - 2280 HV RijswijkTel. (+31-70) 340-2040, Tx. 31 651 epo ni, Geffen, NFax: (+31-70) 340-3016Form PCT/ISA/210 (second sheet) (July 1992)page 1 of 2INTERNATIONAL SEARCH REPORT Internation Application NoPCT/US 01/02331C.(Continuation) DOCUMENTS

CONSIDERED TO BE RELEVANTCategory 0 Citation of document, with indication,where appropriate, of the relevant passages Relevant lo claim No.Y US 5 197 332 A (A. A. SHENNIB 1-9930 March 1993 (1993 30) 27-41943944,46-52@64-68column 3, line 21 -column 4, line 8column 7, line 29 -column 9, line 45Y DE 196 00 234 A (AURIC HOOORSYSTEME GMBH St 27-4L44CO. KG) 10 July 1997 (1997 10)column 1, line 35 - column 4, line 8Y DE 198 15 373 A (SIEMENS AUDIOLOGISCHE 27-4L44TECHNIK GMBH)14 October 1999 (1999 14)column 1, line 54 -column 5, line 14PIA WO 00 64350 A (A. CZYZEWSKI ET AL 1-26@4392 November 2000 (2000 02) 46-52964-68the whole documentA DE 299 05 172 U (AURIC HORSYSTEME GMBH & 1-79CO. KG) 10 June 1999 (1999 10) the whole documentA US 3 808 354 A (M. PRESLAR ET AL 1-9143,30 April 1974 (1974 30) 46-49the whole documentForm PCT/ISA/210 (continuation of second sheet) (July 1992)page 2 of 2INTERNATIONAL SEARCH REPORTInternation Application NoInformation on patent family members - -PCT/US 01/02331Patent fam Publicationcited in search report date member(T datePatent document PublicationUS 4284847 A 18 1981 NONE---------- --------- ---------- ---------- US 5928160 A 27 1999 NONE---------- - ----------US 5197332 A 30 1993 NONE--. ---------- ---------- ---------- ----------DE 19600234 A 10 1997 NONE--------- ----------DE 19815373 A 14 1999 NONE---------- ---------- ---------- ---------- ----DE 29905172 U 10 1999 WO 0057672 A 28 2000DE 20004908 U 10 2000--------- ---------- ----------US 3808354 A 30 1974 NONE---------- ---------- ----------Form PCT/ISA/21 0 (patent farnity annex) (July 1992)

Other Abstract Info: none

Foreign References: No patents reference this one



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